CLAIMS

We claim:

1. An aqueous sizing composition for glass fibers comprising:

a starch mixture comprising a high viscosity starch and a low viscosity starch cooked at a temperature sufficient to solubilize at least 50% of the high viscosity starch and to solubilize at least 50% of the low viscosity starch.

2. The aqueous sizing composition of claim 1, wherein the starch mixture is cooked at a cooking temperature sufficient to solubilize at least 80% of the low viscosity starch.

3. The aqueous sizing composition of claim 1, wherein the starch mixture is cooked at a cooking temperature sufficient to solubilize at least 80% of the low viscosity starch and to solubilize at least 75% of the high viscosity starch.

4. The aqueous sizing composition of claim 1, wherein the starch mixture is cooked at a cooking temperature sufficient to solubilize at least 90% of the low viscosity starch and to solubilize at least 80% of the high viscosity starch.

5. The aqueous sizing composition of claim 1, wherein the high viscosity starch comprises an unmodified starch having an amylose content of > 50% and the low viscosity starch comprises a modified starch comprising > 50% amylose.

6. The aqueous sizing composition of claim 5, wherein the ratio of high viscosity starch to low viscosity starch ranges from 1.5:1 to 2:1, respectively.

7. The aqueous sizing composition of claim 5, wherein the low viscosity starch comprises a propylene oxide modified starch.

8. The aqueous sizing composition of claim 1, further comprising at least one emulsifier in an amount effective to produce an emulsion in water of said nonionic lubricant.

9. The aqueous sizing composition of claim 1, further comprising a cationic lubricant.

10. The aqueous sizing composition of claim 9, wherein the cationic lubricant comprises an alkylimidazoline.

11. The aqueous sizing composition of claim 1, further comprising a biocide in an amount sufficient to inhibit organic growth in said sizing composition.

12. The aqueous sizing composition of claim 1, further comprising a silane coupling agent.

13. The aqueous sizing composition of claim 12, wherein the silane coupling agent comprises gamma-glycidoxypropyltrimethoxy silane.

14. The aqueous sizing composition of claim 1, further comprising a defoamer in an effective amount to reduce foaming during mixing of the aqueous sizing composition.

15. The aqueous sizing composition of claim 1, further comprising a nonionic lubricant comprising an oil and a plurality of ester waxes formed from reacting a monocarboxylic acid and a monohydridic alcohol.

16. The aqueous sizing composition of claim 15, wherein the plurality of ester waxes is a solid having a melting point of from about 40 °C to about 70 °C.

17. The aqueous sizing composition of claim 15, wherein the monocarboxylic acid is selected from the group consisting of octanoic acid, capric acid, lauric acid, tridecanoic acid, myristic acid, pentadecanoic acid, and palmitic acid.

18. The aqueous sizing composition of claim 15, wherein the monohydric alcohol is selected from the group consisting of myristal alcohol, n-pentadecyl alcohol, cetyl alcohol, margaryl alcohol, stearyl alcohol, n-nonadecyl alcohol, arachidyl alcohol.

19. The aqueous sizing composition of claim 15, wherein the plurality of ester waxes are formed from reacting a monocarboxylic acid having between 8 and 14 carbons with a monohydridic alcohol having between 16 and 18 carbons.

20. The aqueous sizing composition of claim 15, wherein the plurality of ester waxes comprises hexadecyl octanoate, octadecyl octanoate, hexadecyl laurate, octadecyl laurate, octadecyl myristate, and octadecyl palmitate.

21. The aqueous sizing composition of claim 20, wherein the amount of non-ionic lubricant in the sizing is between 25 and 35 weight percent.

22. The aqueous sizing composition of claim 20, wherein the ratio of wax to oil is between 2:1 and 3:1.

23. A glass fiber at least partially coated with the residue of a sizing composition comprising:

a starch mixture comprising a high viscosity starch and a low viscosity starch cooked at a temperature sufficient to solubilize at least 50% of the high viscosity starch and to solubilize at least 50% of the low viscosity starch.

24. The glass fiber of claim 23, wherein the starch mixture is cooked at a cooking temperature sufficient to solubilize at least 80% of the low viscosity starch.

25. The glass fiber of claim of claim 23, wherein the starch mixture is cooked at a cooking temperature sufficient to solubilize at least 80% of the low viscosity starch and to solubilize at least 75% of the high viscosity starch.

26. The glass fiber of claim 23, wherein the starch mixture is cooked at a cooking temperature sufficient to solubilize at least 90% of the low viscosity starch and to solubilize at least 80% of the high viscosity starch.

27. The glass fiber of claim 23, wherein the high viscosity starch comprises an unmodified starch having an amylose content of > 50% and the low viscosity starch comprises a modified starch comprising > 50% amylose.

28. The glass fiber of claim 27, wherein the ratio of high viscosity starch to low viscosity starch ranges from 1.5:1 to 2:1, respectively.

29. The glass fiber of claim 27, wherein the low viscosity starch comprises a propylene oxide modified starch.

30. The glass fiber of claim 23, wherein the sizing composition further comprises at least one emulsifier in an effective amount to produce an emulsion in water of said nonionic lubricant.

31. The glass fiber of claim 23, wherein the sizing composition further comprises a cationic lubricant.

32. The glass fiber of claim 31, wherein the cationic lubricant comprises an alkylimidazoline.

33. The glass fiber of claim 23, wherein the sizing composition further comprises a biocide in an amount sufficient to inhibit organic growth in said sizing composition.

34. The glass fiber of claim 23, wherein the sizing composition further comprises a silane coupling agent.

35. The glass fiber of claim 34, wherein the silane coupling agent comprises gamma-glycidoxypropyltrimethoxy silane.

36. The glass fiber of claim 23, wherein the sizing composition further comprises a defoamer in an effective amount to reduce foaming during mixing of the aqueous sizing composition.

37. The glass fiber of claim 23, wherein the sizing composition further comprises a nonionic lubricant comprising an oil and a plurality of ester waxes formed from the reacting a monocarboxylic acid and a monohydridic alcohol.

38. The glass fiber of claim 37, wherein the plurality of ester waxes is a solid having a melting point of from about 40 °C to about 70 °C.

39. The glass fiber of claim 37, wherein the monocarboxylic acid is selected from the group consisting of octanoic acid, capric acid, lauric acid, tridecanoic acid, myristic acid, pentadecanoic acid, and palmitic acid.

40. The glass fiber of claim 37, wherein the monohydric alcohol is selected from the group consisting of myristal alcohol, n-pentadecyl alcohol, cetyl alcohol, margaryl alcohol, stearyl alcohol, n-nonadecyl alcohol, arachidyl alcohol.

41. The glass fiber of claim 37, wherein the plurality of ester waxes are formed from reacting a monocarboxylic acid having between 8 and 14 carbons with a monohydridic alcohol having between 16 and 18 carbons.

42. The glass fiber of claim 37, wherein the plurality of ester waxes comprises hexadecyl octanoate, octadecyl octanoate, hexadecyl laurate, octadecyl laurate, octadecyl myristate, and octadecyl palmitate.

43. The glass fiber of claim 42, wherein the amount of non-ionic lubricant in the sizing is between 25 and 35 weight percent.

44. The glass fiber of claim 42, wherein the ratio of wax to oil is between 2:1 and 3:1.

45. A glass fiber strand comprising a plurality of glass fibers of claim 23.

46. The glass fiber strand of claim 45, wherein the diameter of the glass fibers is between 8.0 to 11.0 microns and the glass fiber strand comprises from 200 to 800 glass fibers.

47. A method of producing an at least partially coated glass fiber comprising:

applying to a glass fiber the sizing composition of claim 1.

48. A method of weaving comprising:

feeding a plurality of warp yarns into a loom to form a shed; and

feeding a plurality of glass fiber strands into the shed formed by the warp yarns,

wherein

the glass fiber strands comprise a plurality of glass fibers of claim 22.

49. The method of claim 48, wherein the diameter of the glass fibers of the glass fiber strands is between 8.0 to 11.0 microns and the glass fiber strand comprises from 200 to 800 glass fibers.

50. The method of claim 48, wherein the loom comprises an air jet loom.

51. The method of claim 48, wherein the plurality of glass fiber strands have substantially no twist.